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the best way to bolt...

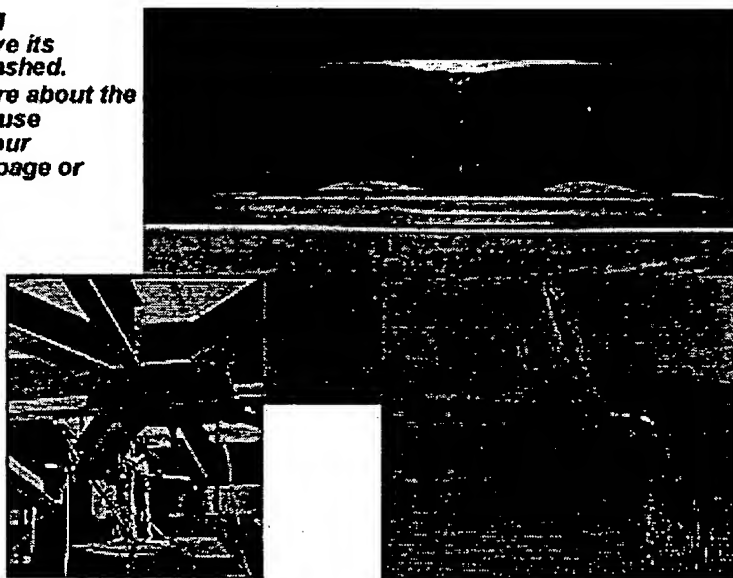
*Direct Tension Indicators
for Bolting Quality Assurance*

Manufacturer of Direct Tension Indicators for the steel construction industry world wide.



*What are DTI's, who's using them and why,
how to use them and why you should be too!*

***This is a DTI
about to have its
bumps squashed.
To learn more about the
best way to use
DTI's go to our
Installation page or
click here!***



Why DTI's

***See some of our projects around the globe and
hear from people who install them
and why they specified DTI's***

what's new

Important new addition - Masterformat Specification

In collaboration with a very innovative company called E-SPECS, we have developed a complete Structural Steel specification written according to the AIA Masterformat headings. As the governing specification changes we will update it continually. You can [view and download it now.](#)

ABT Quality Assurance Lab Accredited by PRI/NADCAP to the Fastener Quality Act/ISO Guide 25

The Applied Bolting Technology Products, Inc. Quality Assurance Laboratory has received accreditation from PRI/NADCAP for the testing, inspection and certification of direct tension indicating washers manufactured to ASTM Standard F959 as required by the Fastener Quality Act.

Accreditation was achieved in a timely manner due to the laboratory's preparedness and ISO-based quality system, which has been in place

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since the company's
founding four years ago.

By having an accredited
in-house quality
assurance laboratory,
Applied Bolting is better
able to respond promptly
to customer needs and
generate superior
service.

Applied Bolting's director
of Quality Assurance,
John Herr, may be
contacted for information
regarding the
laboratory's accreditation
by email:
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the best way to bolt...

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Why DTI's?

Because DTI's are completely independent of the bolt's torque resistance, they are the simplest, most cost effective method of bolting quality assurance.

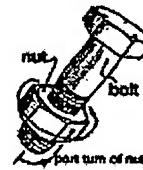
There are four and only four methods allowed to measure whether structural bolts are correctly installed. When used correctly, all four methods will produce correctly tensioned bolts, but all four methods differ in complexity and effectiveness. Because DTI's are the simplest and because they are torque independent, many construction professionals consider DTI's the best. See what the Pros have to say.

But you should decide for yourself. Whatever your role in the project team, we'll show you how DTI's work to your benefit. Click on what you do, then see what DTI's do for you!

Are you an

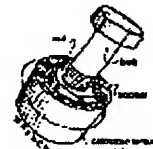
- Inspector ? - DTI's are safer, simpler, and catch bad bolts too
- Erector ? - no inspector hassle, no call-backs
- Fabricator ? - DTI's can save you money see Total Installed Cost
- Designer ? - get the important bolts tight, every time
- Owner ? - DTI's send a quality message to the team
- EPC Contractor ? - DTI's improve constructability

Methods ...



Turn-of-Nut

Turn-of-Nut details

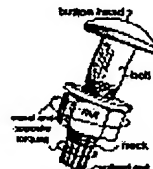


Calibrated Wrench

Calibrated Wrench details



Direct Tension Indicator details



Twist-off Bolt details

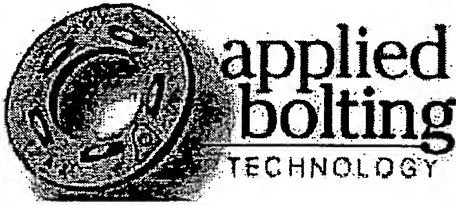
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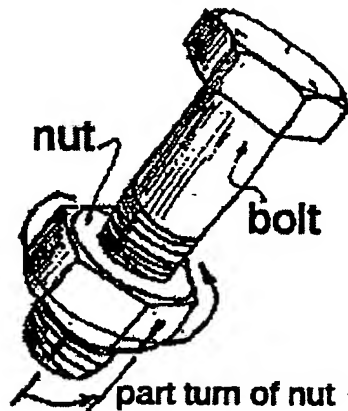
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Turn-of-Nut

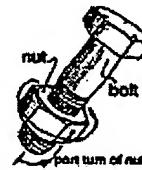
"Turn-of-nut" or "part turn"

After snugging the joint, the bolt shank and nut is marked and then a specific amount of rotation is induced between the nut and the bolt. The amount of rotation differs for different bolt lengths and diameters and therefore must be known and understood by the bolt installers in advance. The success of the method is dependent on a correct snugging of the joint, and is dependent on the bolt head being held from turning so the bolt does not spin in the hole.

Two persons are therefore **MANDATORY** to execute this method correctly – one to hold the bolt from turning or "rolling" and the other person to operate the wrench.

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Methods ...



Turn-of-Nut

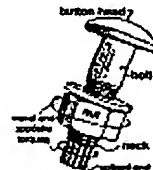
Turn-of-Nut details



Calibrated Wrench details



Direct Tension Indicator details



Twist-off Bolt details

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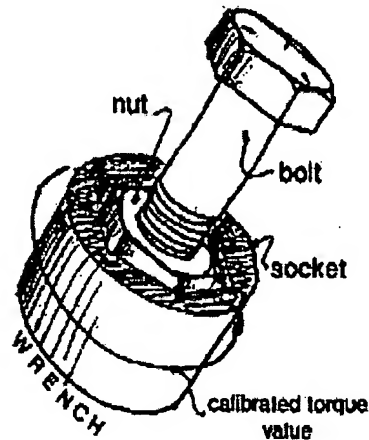
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Calibrated Wrench

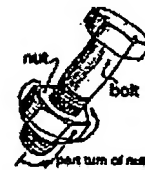
"Calibrated Wrench"

This method is sometimes known erroneously as "torque control". The Research Council stipulates that each day, for each different diameter, length, and grade of bolts, a representative sample of three bolts must be selected to calibrate a wrench.* The bolts are tensioned in a Skidmore-Wilhelm bolt tension calibrator on the site to measure (i.e. "calibrate") how much torque it takes to get the bolts up to the correct tension.** The wrench is then set to cut out at that torque (the wrench becomes "calibrated"), and then all similar bolts that day are installed to that torque after the joint is snugged first. Rotation during the tightening process must be limited to a specific value. On the next day another set of torques is similarly established and the wrench(s) calibrated again. And so on. Tables of torque by bolt size and diameter are not applicable, and this entire method is not allowed in Canada. Actual results of tension in bolts produced by this method are acknowledged to be highly variable, even when this method is followed religiously, which is rarely the case.

*By "representative sample" they mean bolts in the same condition as the ones that are about to be tightened.

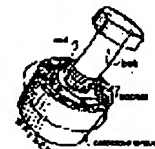
**That is, to a tension 5% higher than the specified minimum.

Methods ...



Turn-of-Nut

Turn-of-Nut details

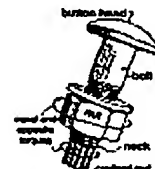


Calibrated Wrench

Calibrated Wrench details



Direct Tension Indicator details



Twist-off Bolt details

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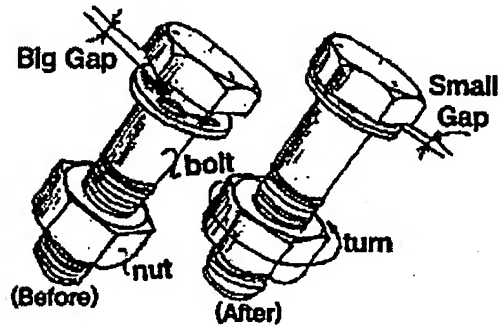
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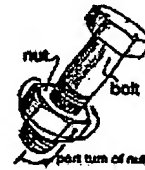
Direct Tension Indicators

"Direct Tension Indicator"

DTI's are like little individual weigh scales, which measure the bolt tension developed during tightening, regardless of the torque resistance of the bolt. By far the simplest method, a DTI is put on one or the other end of all bolts, and after snugging the joint by partially (but not fully) compressing the DTI, all the DTI's are "crushed" to the point where a feeler gage cannot be inserted half way around. DTI's are completely independent of the torque resistance of the bolt assembly, and because the compression of the DTI bumps can be seen by the eye, even without a feeler gage, bolt installers tend NOT to leave the bolts with insufficiently compressed DTI's. Inspection by using a feeler gage (on a sample of the bolts only) can be done by anyone at any time. If the DTI is put on the nut end of the bolt, tightening can be done by one person because it is not necessary to hold the bolt roll.

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Methods ...



Turn-of-Nut

Turn-of-Nut details

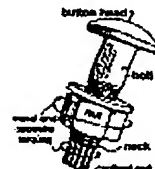


Calibrated Wrench

Calibrated Wrench details



Direct Tension Indicator details



Twist-off Bolt details

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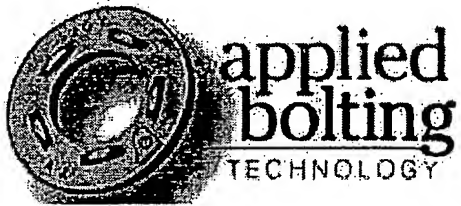
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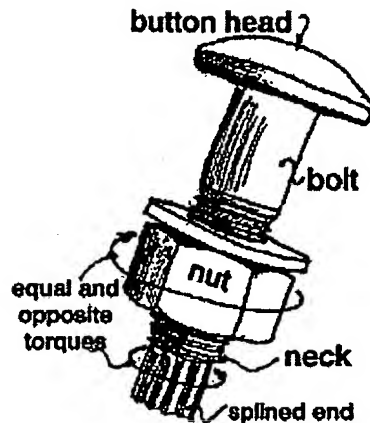
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Twist-off Bolts

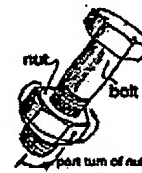
"Other"

Usually this method defaults to "twist-off" bolts. Twist-off bolt assemblies work by calibrating the torque required to twist off a splined extension manufactured into the bolt shank. It is, therefore, a torque-controlled device, and has as its principal advantage its ability to be tightened from one side by one person.

There are a number of disadvantages to the system including special clearance precautions to allow the electric wrenches to be attached to the bolt, including higher cost when compared to regular hex head bolts and DTI's, and including the prohibition of any field relubrication. Its principal disadvantage, frequently encountered on construction sites, is the deterioration of bolt tension as dust, time, and weather conditions change the factory-set torque-tension relationship. KULAK has reported this in ASCE paper [No.14964](#). Available for download.

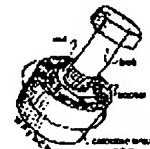
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Methods ...



Turn-of-Nut

Turn-of-Nut details



Calibrated Wrench

Calibrated Wrench details




Direct Tension Indicator details



Twist-off Bolt
Twist-off Bolt details

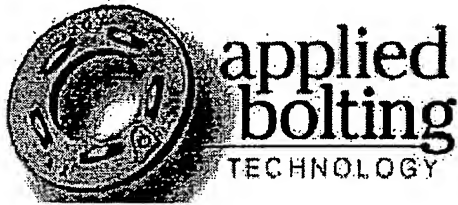
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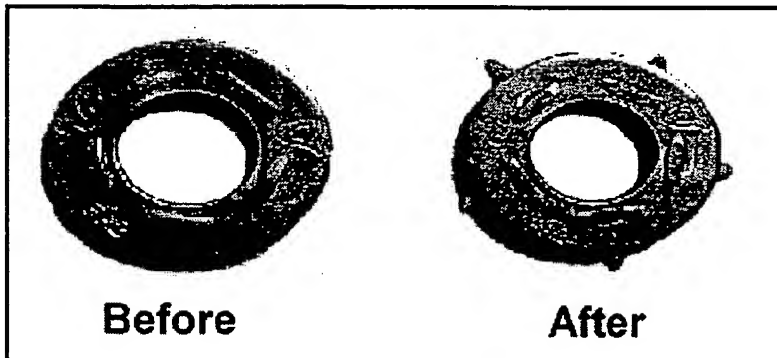
SQUIRTERS – WOW!

THE FASTEST WAY TO THE NEXT BOLT

Why Use "SQUIRTERS" From Applied Bolting

Every year between 100 and 150 million heavy hex structural bolts are tightened in the USA. If you include non-structural cap screws the number gets far higher. If these bolts get tightened at the rate of 20 per man-hour, the total cost of labor involved in tightening these bolts is between 500 million and one billion dollars.

Imagine a device that would allow every one of these bolts to be tensioned correctly and yet saved a fifth of the installation cost or more.



The men and women who do the tightening work, who want to do a good job when they tighten the bolts, must work quickly too. One of their big problems is knowing when to stop tightening the bolt. Too soon and the bolt's loose. Too late and the bolt breaks.

This is the problem Applied Bolting's new "Self-Indicating" or "Squirter" DTI solves, while still saving installation labor. In the words of a very experienced senior executive of the Ironworker's union, when he first saw a squirter, "...Wow. I think that's a great idea. It's simple, but what a great idea. That's a heck of an

Standard DTI's
Self-Indicating (Squirter)
DTI's
Low Load DTI's
Non-Impacting Electric
Wrench

Installation Instructions for Squirter DTI's

Here's what Leo Coar, Publisher of "Distributor's Link" magazine, says about our new "self-indicating" DTI:

"Just when you think there's not much really new and remarkable in the bolting business, wham! Along comes Applied Bolting with this new style DTI that tells the installer when to stop tightening! I think it's a great product with a thousand applications.

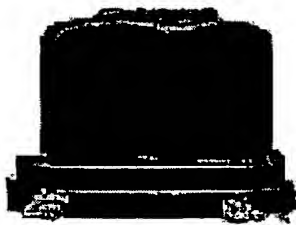
What else is Applied Bolting working on up there in Vermont?"

improvement. You've got something there..."

Ironworkers have known that DTI's represent the very best practical technology available to control bolt tension on construction sites. They know that DTI's are not affected by the variable torque resistance of different bolt lengths, diameters, grades, and thread conditions. They know that if they carefully tightened the bolts until the DTI bumps are compressed just right, they could do an excellent job on any bolt. Tightening just to the point where the little feeler gage would NOT go into half the DTI gaps between the DTI and the bolt head or flat washer, but WOULD go into the other gaps, was just the right point. And experienced DTI installers get pretty good at judging the little gap by eye.

But for many bolt installers, judging the residual DTI gap to be just right was a chore, so they tended to compress the DTI's completely flat so there was no gap at all. For many structures, this is quite OK. For others, however, it might not be.

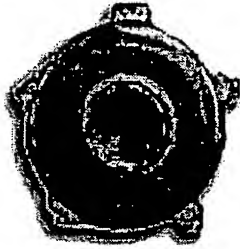
But now, with the advent of a simple little feature on the DTI which causes them to "squirt" out an orange



indicating silicone material when the DTI bumps are compressed enough, the erectors can get all the bolts tightened nicely over the minimum, quickly, and without having to judge the little DTI gap. With "Squirters", they can really get out ahead and make time and still do the job right.

The "Squirter" DTI looks exactly like a regular DTI. In fact it is a regular DTI made to ASTM F959. But there's a big difference. When the bolt has been tightened over the minimum tension, the bolt installer sees an orange-colored Loctite silicone squirting out from under the washer. When he sees these, he's done, and can stop tightening. It's that simple. Erectors don't have to judge the little DTI gap. It's far easier than turn-of-nut because they don't have to remember whether to stop at one-third, one-quarter, or two-thirds turn after snug. It's far easier than calibrated wrench because they don't have to check the torque resistance of the bolt. And, compared to twist-off bolts, the erector doesn't have to worry about the twist-off end of the TC bolt shearing off in torsion before the bolt comes up to the right tension, or getting loose and becoming a safety hazard.

Now erectors can really make time when using DTI's, because it's easy to see when the bolt has enough tension. Whether the bolt is rusty, greasy, long, short, fat, or skinny, the bolt installer just makes sure that enough red stuff squirts out of the DTI so he knows the bolt has



been tensioned over the minimum. No guessing about what torque to use. No inserting a feeler gage for the bolt installer. And the Loctite works down to minus 60 degrees Fahrenheit and up to over +150 degrees.

For the inspector, it's business as usual, but with a welcome new twist. The inspector can use a feeler gage just like on regular ASTM F959 DTI's. But what we've found is, after the inspector and installers test the "Squirter" DTI's in a Skidmore before the bolting starts, they get a feeling about how much bolt tension develops when the red silicone squirts out. Seeing this happen in the steelwork makes the inspector's job even easier. And if there's any doubt about whether the DTI has been compressed enough, the inspector can get out the feeler gage and tell for sure, because the DTI is, after all, just the same old DTI as before.

Applied Bolting has patented this product (US Patent No. 5,931,618).

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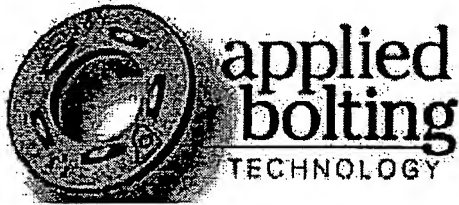
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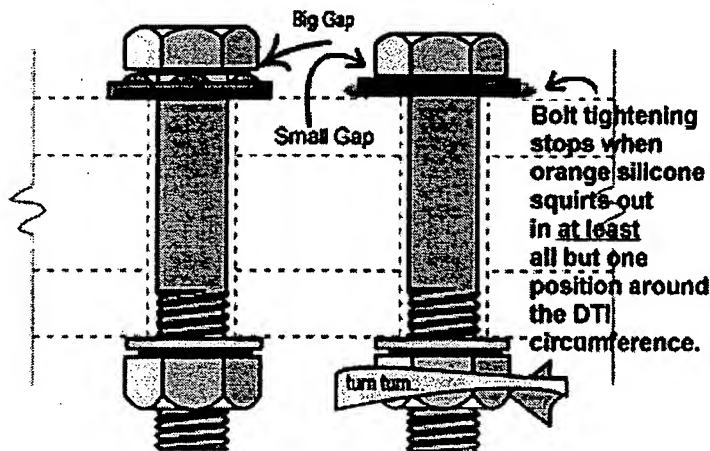
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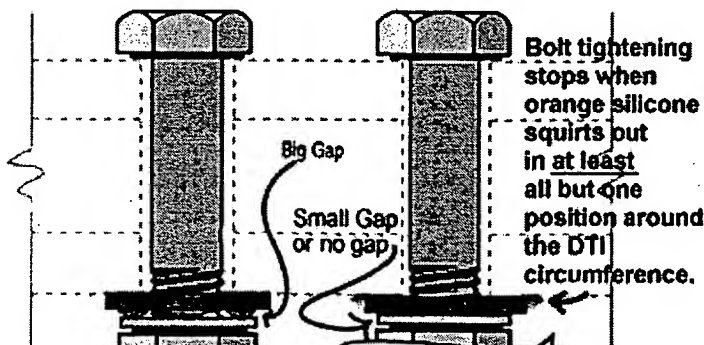
SELF-INDICATING (SQUIRTER) DTI INSTALLATION

Note: Before commencing installation, the new self-indicating DTI's **MUST** be calibrated in a Skidmore or by checking the DTI gap with a feeler gage, to allow correct interpretation of the volume and timing of the orange silicone which squirts out.

Two Person Installation:



One Person Installation:



General Installation
instructions for Standard DTI
installation

The Fine Print
more on installation and
inspection

Application Advisory
regarding 1 1/8" and 1 1/4"
diameter A490 Bolts in
oversized holes

Application Advisory
regarding Hot Dip
Galvanized flat washers

Squirter Installation
instructions for installing Self
Indicating (Squirter) DTI's



In simple terms, the installation instruction is

After the orange silicone appears in volume around most of the DTI circumference, stop tightening the bolt."

For optimum erector efficiency, however, squirter DTI's must be calibrated before using them in a structure.

In a Skidmore bolt tension calibrator, place a few representative sample bolt, nut, flat washer, and squirter DTI assemblies. Tighten the bolt to about 10% over the minimum required tension with any wrench in about five to ten seconds. Do not tighten slowly by hand. Note the appearance, flow volume, and number of orange silicone "squirts" emanating from under the DTI at that tension. The number of "squirts" should be equal to AT LEAST the number of bumps on the DTI less one. In the steelwork, tighten the bolts so that the "squirt" conditions seen in the Skidmore calibration is duplicated. If there is any doubt about whether the DTI has been sufficiently compressed, check whether a feeler gage of the correct thickness will not go into half of the DTI gaps. If the feeler gage does go in more than half the DTI gaps, tighten the bolts so that a little more of the silicone squirt volume appears before stopping the tightening effort.

If a Skidmore is not available for this test, simply repeat the test above in a solid connection, and check the DTI compression at the point where there appears to be sufficient silicone squirting out. To check the DTI compression, using the correct thickness feeler gage, make sure that the feeler gage will not go into the half of the DTI gaps. This means that the bolt tension must be above the minimum.

For installation of squirters in old or reconditioned steelwork, it may be necessary to place a hard flat washer against the steel surface and under the squirter so that its squirt feature works reliably.

Applied Bolting has patented this product (US Patent No. 5,931,618).

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